The Making of the Map

16 November, 1915.

ALEXANDER ROSS, President,
in the Chair.

(*Paper No. 4137.*)

"The Punjab Triple Canal System."

Sir JOHN BENTON, K.C.I.E., F.C.H., M. Inst. C.E.

THE name "Punjab" (or "Panjab") is derived from two native words (*panj*, meaning five, and *ab*, water), and, though now applied to the whole of the British Province of that name in the North-West of India, was originally restricted to Ranjit Singh's Sikh kingdom, which was truly the "Land of the five rivers," as it was traversed by the Sutlej, Beas, Ravi, Chenab, and Jhelum, all perennial rivers, all rising in the Himalayas, and all tailing eventually into the mighty Indus, which is known by natives under the name of the Sind river (Fig. 1, Plate 1).

The tracts between these rivers are known locally as "Doabs" (from *do*, meaning two, and *ab*, water), and are distinguished from each other by the initial letters of the rivers bounding them; thus the Bari Doab indicates the tract between the Beas and the Ravi, the Rechna Doab that between the Ravi and the Chenab, and the Jech, or Chaj Doab, that between the Chenab and the Jhelum rivers.

The soil is usually rich alluvium, often of great depth, and the ground-level contours of the country are generally parallel to the Himalayas, the lines of steepest slope (i.e., at right angles to the contours) being for the most part nearly parallel to the rivers.

The configuration therefore is such as to lend itself admirably to the construction of irrigation-works, and it is consequently not surprising that great advances should have been made in this direction since the annexation of the Punjab about the middle of the last century.

A Splendid Land Lying Waste

The position was that on the east of the Central Punjab there was a great tract of more than 1½ million acres of splendid land lying waste for want of water that could not be supplied from any source near at hand, because the perennial supplies from the Sutlej, Ravi, and Chenab had already been fully utilized, whilst the water of the Beas, an affluent of the Sutlej, had been reserved for a vast arid tract on the east of the latter river.

On the other hand, it had only been possible to utilize about a quarter of the perennial supply carried by the Jhelum river, and accordingly the suggestion was made that this surplus supply should be diverted to the east for the irrigation of the Lower Bari Doab. It was clear that, unless this were done, the surplus water of the Jhelum must be allowed to run to waste for ever in the ocean, whilst the arid tract of the Lower Bari Doab must be deprived of irrigation for all time.

It was obvious, however, that the conveyance of this surplus perennial water-supply from the west to the east of the province would be by no means a simple problem, as it involved the crossing not only of the Chenab and Ravi rivers, but also that of numerous and formidable hill torrents; and it was clear from the first that the project would necessarily be more than usually costly, and one, indeed, that could not have been undertaken at an earlier stage of the Canal Administration of the Punjab.

Essential for Financial Success

The transfer of water from west to east is only required in the Punjab for the cold-weather low perennial supply, the conditions being as follows:—In the Punjab there are two distinct agricultural seasons and two annual crops. The first of these seasons comprises six hot months, April to September, when the melting Himalayan snows—in conjunction with the rainfall from July to September—afford abundant supplies in the rivers for the summer crop, which is known as the *kharif*. The second season comprises the six cold months, October to March, during which only about 10 per cent. of the annual rainfall is received; most of the rivers then carry low supplies, and transfer from west to east is required for the cold-weather crop, which is known as the *rabi*. Two crops are better than one, and are essential for financial success; all the most successful canals in the north of India are perennial and furnish adequate supplies of water for both *kharif* and *rabi*.

The surplus produce from the tracts under the new canals will be carried by the existing Government railways to the port of Karachi, and the net profit to the Railway Department, after deducting 50 per cent. for working-expenses, will be about as much as the net revenues of the Irrigation Department; all that is likely to be said about this great windfall, when it occurs, will be that the railways are doing very well. There will be increases of revenue in other departments. The net effect to Government will be that money borrowed at not over 4 per cent. for the execution of the works will bring in about 7·5 per cent. in the Irrigation Department and about as much in the Railway Department, not to mention increased revenues in other departments.

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Furnished inspection-houses have been constructed over the entire canal system at convenient sites, the average distance apart being about 10 miles. Ceaseless supervision, efficient arrangements in the distribution of water, close touch with the cultivators, and prompt attention to all complaints, have marked irrigation administration in India in the past and are essential for continued success in the future.

Canal telegraphs are in general use for the prompt and effective control of water-supply.

The next question which called for consideration was the distribution of the aggregate annual area of 1,875,855 acres between *kharif*, perennial *rabi*, and *rabi* first waterings, the latter being all that is allowed where the sub-surface water-table is high, and water-logging an evil to be guarded against. Preliminary examination of the perennial cold-weather supply in the Jhelum river—available for the *rabi* crop—showed that it would only suffice for about half of the annual irrigation; since equal proportions of *kharif* and *rabi* obtained on some existing canal systems, this subdivision was adopted for the triple system. A higher ratio of *rabi* to *kharif*, such as 1·5 to 1, or 2 to 1, would have served to reduce the canal-capacities; but the data then available offered no promise of this being possible, while shortage of carrying-capacity was—in the light of past experience—an evil to be guarded against. As already explained, the river water-supply is always abundant in

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The head regulator is designed to take in only top water. The training-works enforce a direct approach. The work was built in the dry, in a loop of the river, only three 150-foot leading cuts being dug along the $1\frac{1}{4}$-mile chord. The old channel was left open, and the advent of the great floods was awaited. The river took to the new course, widening the 450 feet of leading cuts to 1,682 feet in one season, while largely silting up the old channel, and driving a straight course through the down-stream winding channel which threatened to cut the canal. These arrangements for "directing the great sources of power in Nature for the use and convenience of man" met with gratifying success.

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Execution of Earthwork

The staff engaged had to overcome great difficulties in finding the requisite labour to carry on the works satisfactorily. The ravages of plague were persistent, and the province lost 10 per cent. of its population, or about two million persons. The three great projects were competing with each other throughout, and most of the labour was imported, and, working only for a season, invariably deserted the works at harvest-time. In the 8 years 1905–6 to 1912–13, when all three projects were vigorously under execution, the strength of the labour forces gradually increased to a maximum in 1911–12 of upwards of 76,000 men and 13,000 animals, with an average for that year of 43,000 men and 7,000 animals.

Watercourses are owned and maintained by the landowners, and the former practice in the case of proprietary lands was for Government to leave their construction to the people who used them. This led to unsatisfactory alignments, to slow development of irrigation, and to retention of all the old fields of irregular sizes and shapes, which gave trouble in the assessment of water-rates. The modern practice is for the land to be subdivided by Government into rect-

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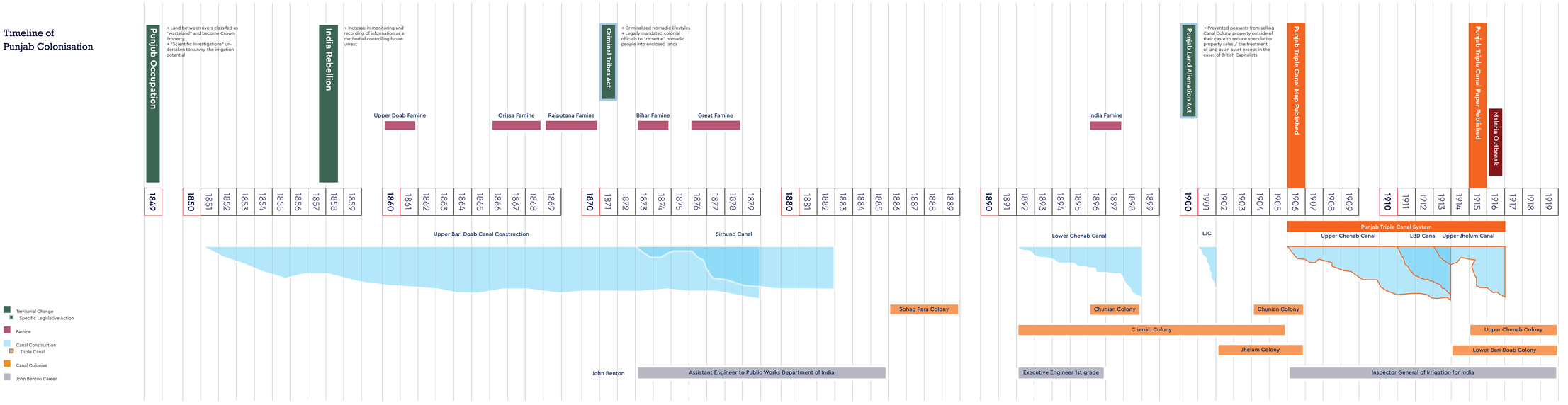
The location of the Lower Bari Doab canal, the last part of the triple project, is shown in Figs. 1 and 4, Plate 1. This canal takes off the Ravi river directly opposite the tail of the Upper Chenab canal, control of the river being secured by a barrage over the channel. The canal attains the crest of the country in the 34th mile, and it supplies an extensive system of distributaries designed to serve the whole commanded area.

In the case of the Lower Bari Doab canal most of the tract was a prairie one, and Government had a perfectly free hand. The original contoured map prepared from cross-section lines 2,000 feet to 2,500 feet apart was unsuitable for the requirements of land-allotment and watercourse-construction. Base-lines were laid out from traverse data furnished by the Indian Survey Department. The tract was divided into blocks 4,400 feet by 3,960 feet, and these were subdivided into sixteen subsidiary blocks, each 1,100 feet by 990 feet (= 25 acres), which are of suitable sizes for allotment

Timeline of Punjab Colonisation


Punjab Occupation
→ Land between rivers classified as "wasteland" and become Crown Property
→ "Scientific Investigations" undertaken to survey the irrigation potential
India Rebellion
→ Increase in monitoring and recording of information as a method of controlling future unrest
Criminal Tribes Act
→ Criminalised Nomadic lifestyles
→ Legally mandated colonial officials to "re-settle" nomadic people into enclosed lands
Punjab Land Alienation Act
→ Prevented peasants from selling Canal Colony property outside of their caste to reduce speculative property sales / the treatment of land as an asset except in the cases of British Capitalists
Punjab Triple Canal Map Published
Punjab Triple Canal Paper Published
Malaria Outbreak
Upper Doab Famine
Orissa Famine
Rajputana Famine
Bihar Famine
Great Famine
India Famine
1849
1850 1851 1852 1853 1854 1855 1856 1857 1858 1859
1860 1861 1862 1863 1864 1865 1866 1867 1868 1869
1870 1871 1872 1873 1874 1875 1876 1877 1878 1879
1880 1881 1882 1883 1884 1885 1886 1887 1888 1889
1890 1891 1892 1893 1894 1895 1896 1897 1898 1899
1900 1901 1902 1903 1904 1905 1906 1907 1908 1909
1910 1911 1912 1913 1914 1915 1916 1917 1918 1919
Upper Bari Doab Canal Construction
Sirhund Canal
Lower Chenab Canal
LJC
Punjab Triple Canal System
Upper Chenab Canal
LBD Canal
Upper Jhelum Canal
Sohag Para Colony
Chunian Colony
Chunian Colony
Chenab Colony
Upper Chenab Colony
Jhelum Colony
Lower Bari Doab Colony
John Benton
Assistant Engineer to Public Works Department of India
Executive Engineer 1st grade
Inspector General of Irrigation for India
Territorial Change
Specific Legislative Action
Famine
Canal Construction
Triple Canal
Canal Colonies
John Benton Career

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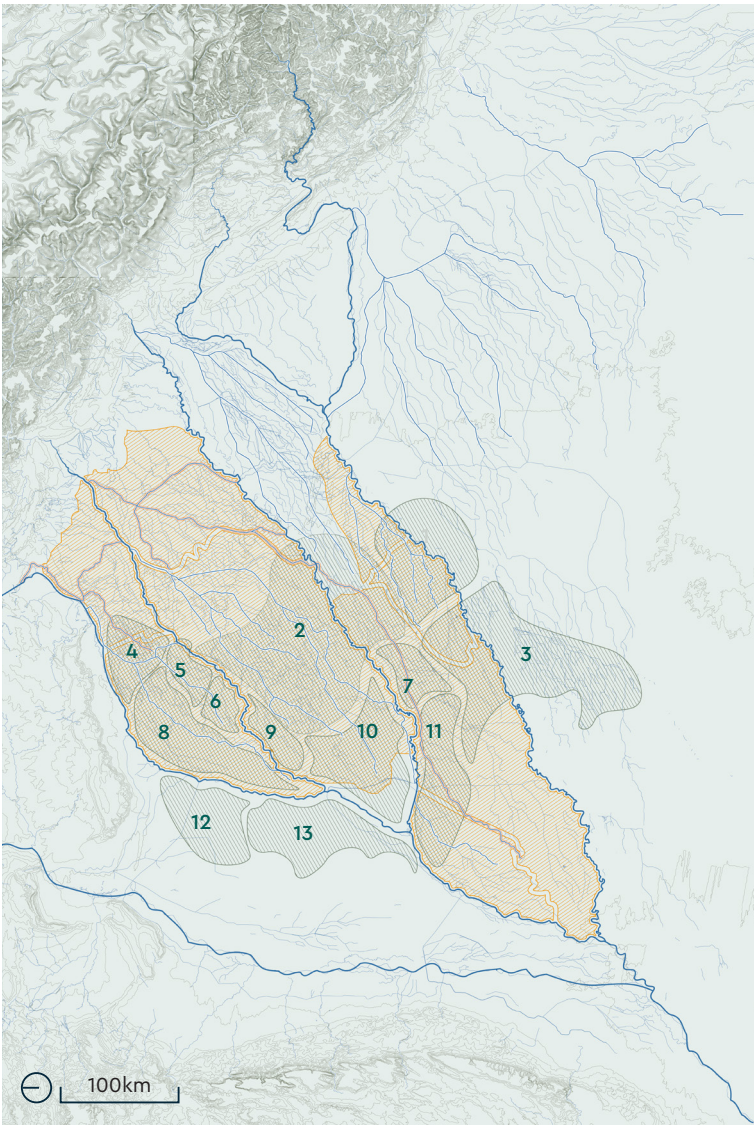
Rapid Development

There are usually two watercourses for each village, with an irrigable area on each of about 800 acres. The usual size of a village is 1,200 to 1,800 acres. The watercourse areas determine the village boundaries, the principle being that the same village community can arrange for subdivision of the water among themselves, but that no watercourse should be shared by two or more villages. Each village has a service road leading to every 25-acre rectangle, and also a road to every adjoining village, while all watercourse crossings of these roads are provided with culverts. The widths of roads are: district 110 feet, main through 88 feet, inter-village 33 feet, intra-village 16·5 feet.

Each rectangle of 25 acres is accurately subdivided into twenty-five plots, each of 1 acre. The main watercourses branch out into others on entering a 25-acre rectangle, and these channels are usually aligned along the sides of the subsidiary acre plots. All demarcation and channel construction inside the 25-acre rectangle is carried out directly by the landowner.

The cost of demarcation, soil-surveys, watercourse- and culvert-construction amounts to about 2 rupees (about 2s. 8d.) per acre, and is recovered from the landowners.

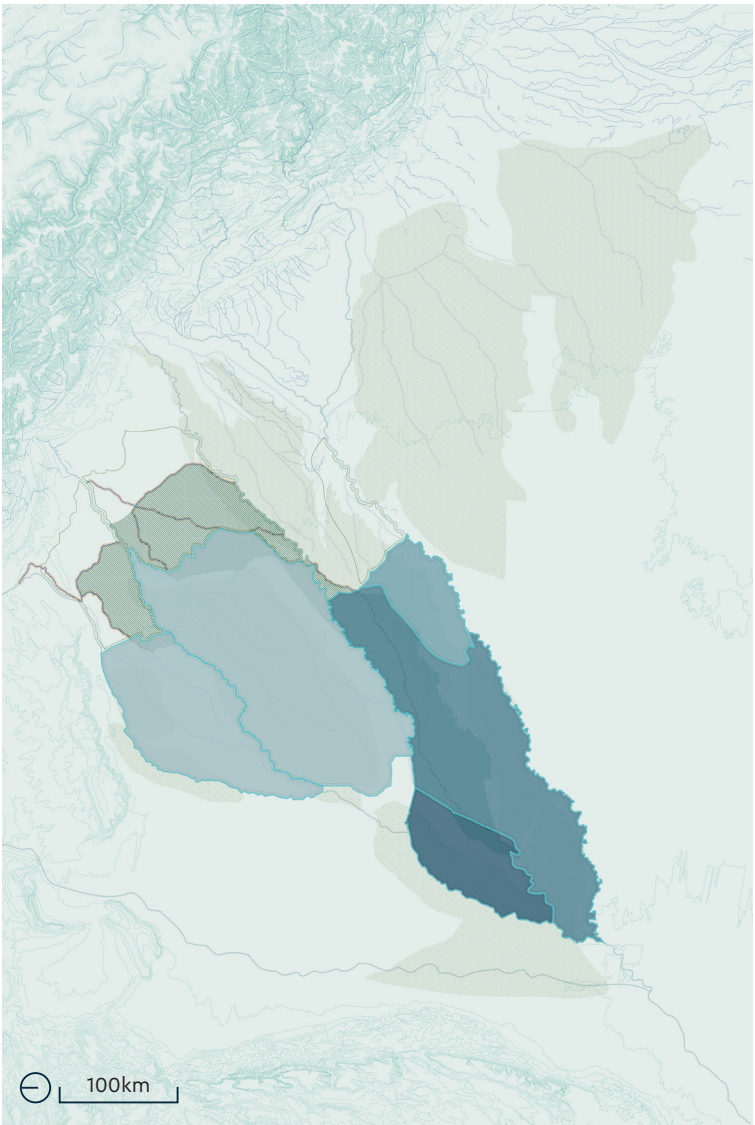
Rapid development of irrigation is encouraged by initial remission of charges for the water; on the Upper Chenab canal, where cultivation was already fully developed, the remission of half rates for one crop resulted in the extent of irrigation for that crop being half of the area estimated to be ultimately obtainable. On the Lower Bari Doab canal the same remission of charges is likely to be made for old villages, but for "colony" lands full remissions of all charges for two crops are contemplated.



Punjab Canal Colonies Overlaid on Indigenous Territories
The Canal irrigation projects involved the occupation of lands and was achieved through dispossessing the semi-nomadic tribal groups in the central bar region. It further disturbed numerous religious sites in the Punjab and used the 5 sacred rivers as resources to exploit.

Territory of pastoral tribes according to Punjab Gazeteer contemporary accounts
1. Wattu 2. Kharral 3. Joiya
4. Gujjar 5. Tarar 6. Ranjha 7. Khathia 8. Gondal 9. Chadhar
10. Bhatti 11, 12,13 . Siyal

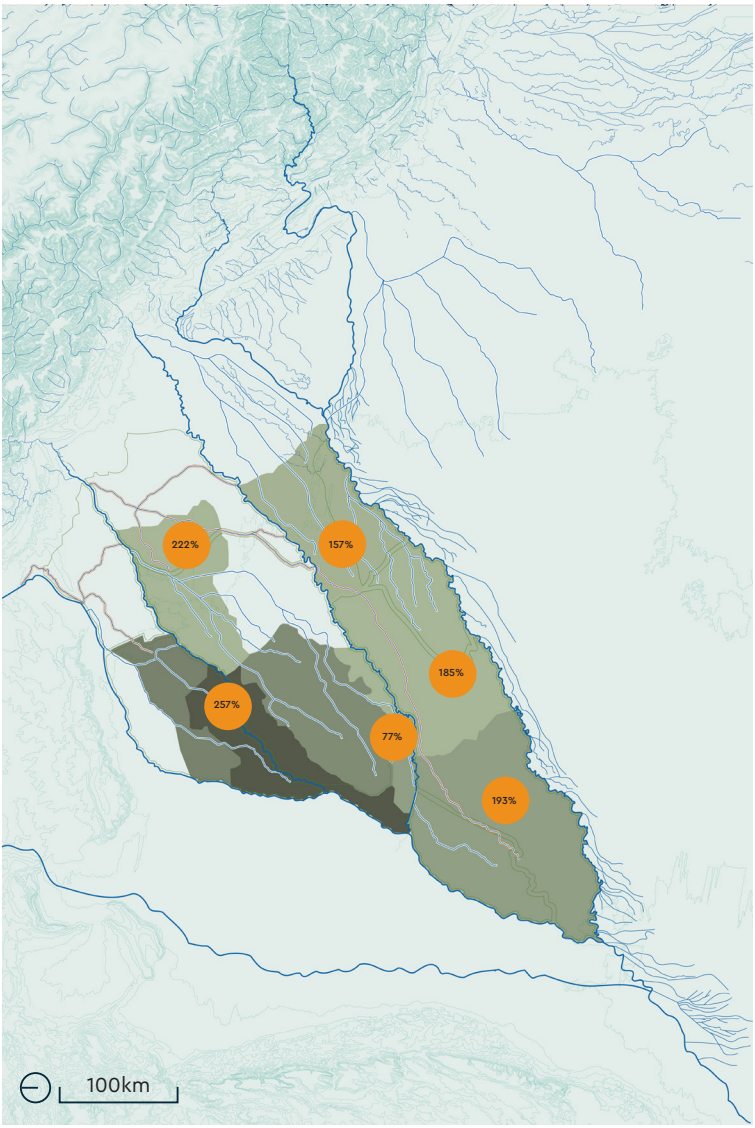
Canal Colony Boundary



Forceful Relocation of Indigenous People unto Colonies
Through the creation of the Canal Colonies the waterflow of the punjab could be seen as a resource to turn land into a site of production and capital accumulation. It further saw those living in the areas as a resource to use in creating this new society

"Jat" Community Members land holding as % of colony's area:
50% 100%

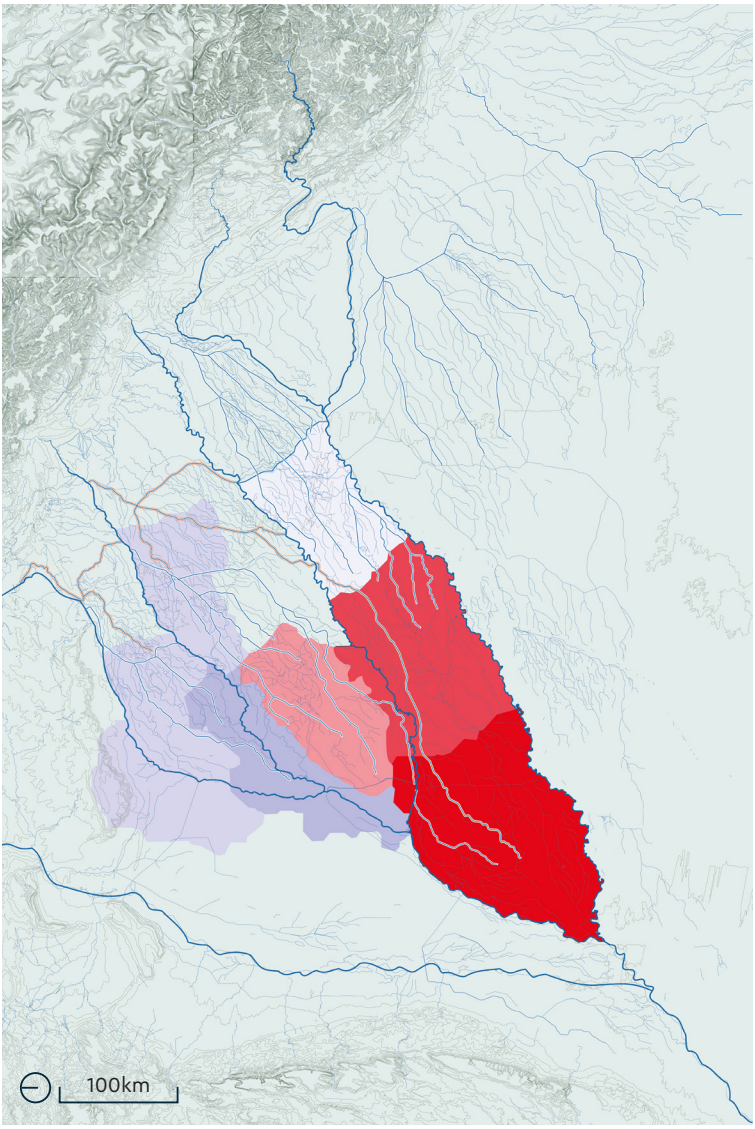
Area Irrigated:
Punjab Canals
Punjab Triple Canal System



Over Taxation and Subsequent Over Reliance on Cash Crops
Financial Success for the British was in tension with success for the farmers and their ability to derive profit or subsist. As rent and taxes increased disproportionately farmers were pressured to focus on "cash crops" which could be exported for higher rates.

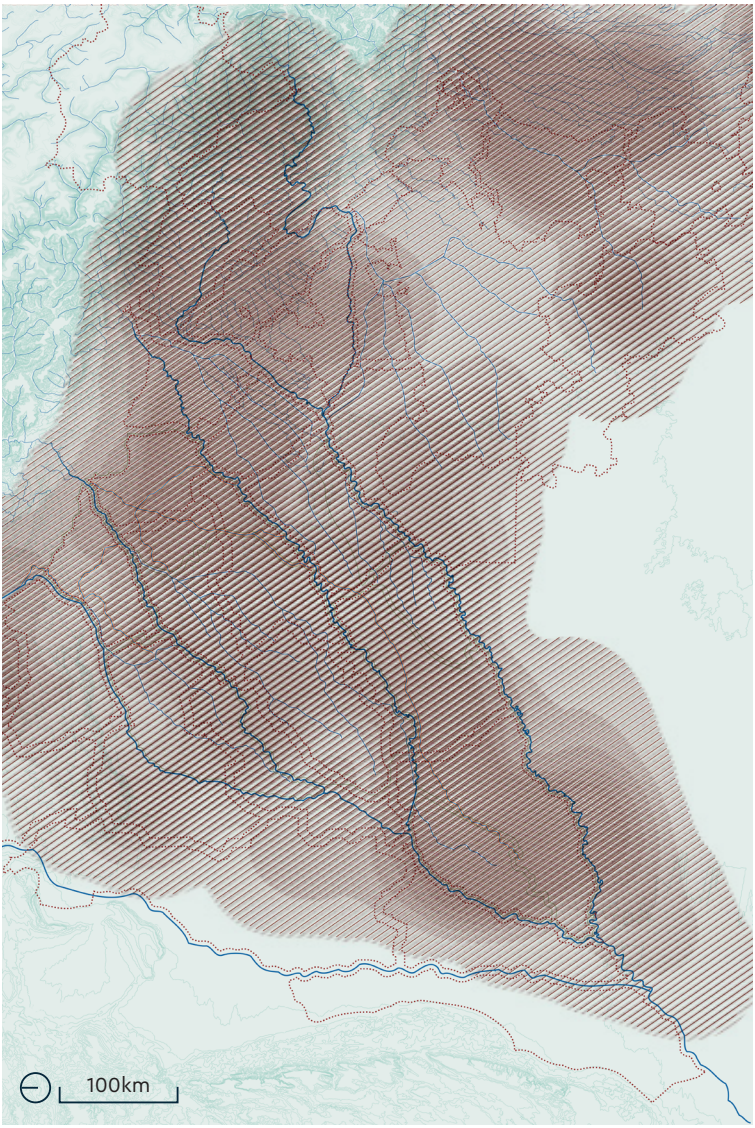
Wheat and Cotton as % of land:
More Less

Land Revenue Increase as a Percentage change from 1875 to 1915, weighted against irrigation area change



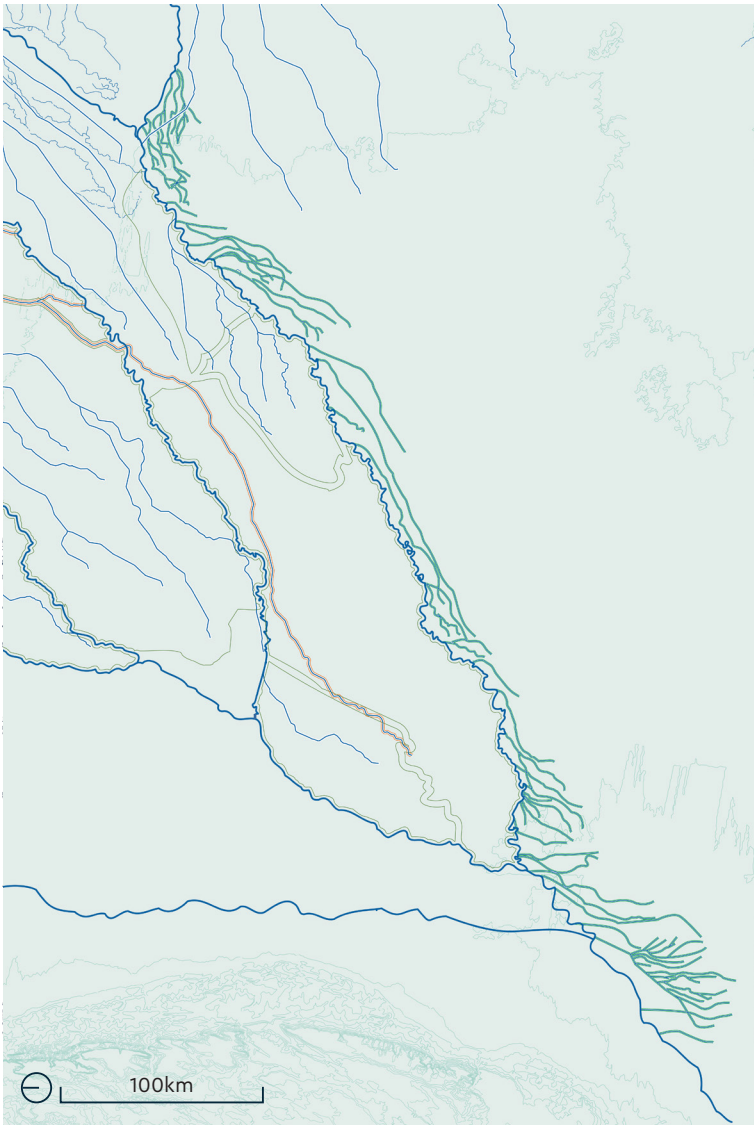
Independent Construction of Wells Challenging the Canals
The Canal Colonies assumed a total control of both people and land. In truth, strain from taxation and failure to deliver the water supply promised led to farmers creating their own wells and disrupt the proposed water system.

Increase in number of Wells in use
over period 1893 – 1908, by district
-100% 100%



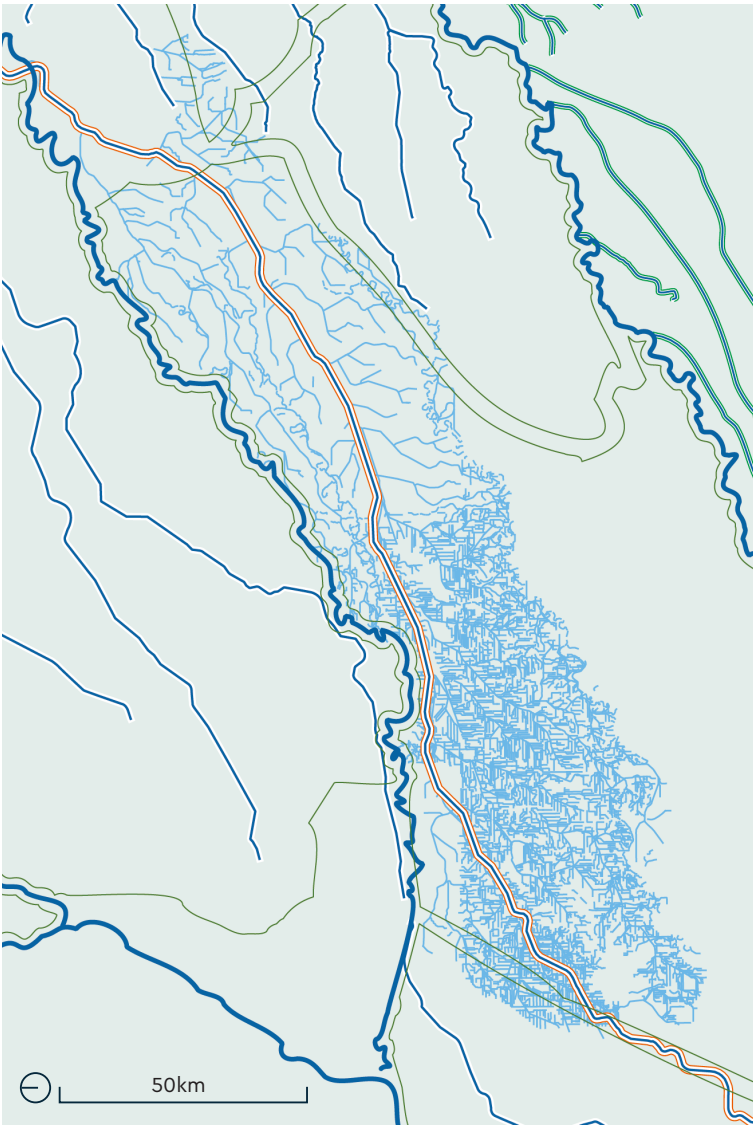
Malaria from Stagnant Water
Unsustainable ratios between perennial crops, alteration in use of ground water and flawed water filtration at headworks lead to severe water logging and with it malaria outbreaks

Heat Map showing Spleen Rate
of 1916 Malaria Outbreak



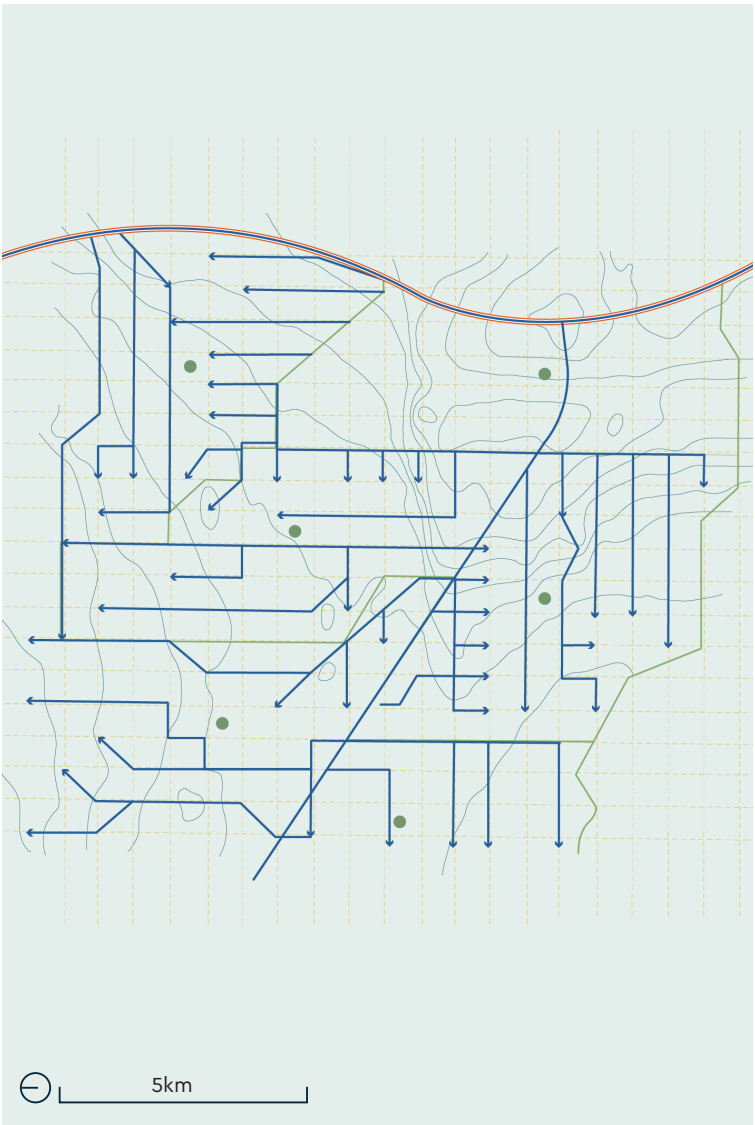
Exploitive Labour Practices
The Triple Canals were constructed following decades of exploitative labour practices, where British Colonial Officers would coerce local farmers to construct canals free of charge.

Canals Constructed under coercion from Colonial leader Colonel Grey prior to the Triple Canal System



"A Land of Squares"
A closer inspection of the Lower Bari Doab at time of writing for Benton shows the ordered layout of space as planned differs was not uniformly achieved

Orthogonal Distributaries of the Lower Bari Doab Canal



Typical Village Layout
The Layout of Villages resulted in enclosed spaces, isolated from their neighbours yet competing over strained resources.

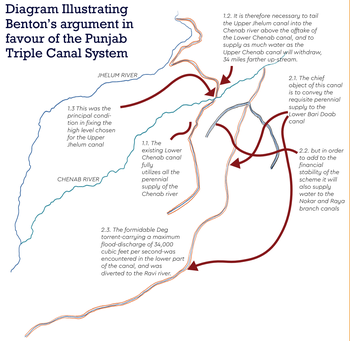
Village
Water source
Canal
Property Grid

RESTRICTED MAP

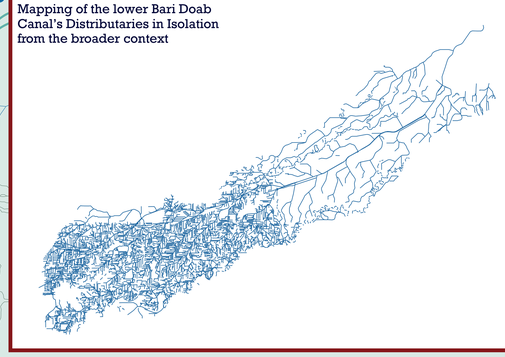
Upper Jhelum Canal Colony
Upper Jhelum Canal
LCC Gujjat Branch
Upper Chenab Canal
UCC Hakhar Branch
UCC Rasul Branch
Jhelum River
Lower JhelumCanal
Jhelum Canal Colony
Chenab River
Lower Chenab Canal
Upper Chenab Canal
Upper Bari Doab Canal
Ravi River
Khushab
Bangi
Thatta
Bangla
Indus River
Sial
Akal Takht Sahib
Chenab Canal Colony
Jhang
Khairal
Chunian Canal Colony
Lower Bari Doab Canal
Bhagat
Bangla
Cahag Para Canal Colony
Wagga
Sutlej River
Keshgarh Sahib
Sirhund Canal
Chenab River
Sidnai Canal Colony
Lower Bari Doab Canal Colony
Sutlej River
Jogia
Damdama Sahib
Jamma Canal

10 20 30 40 50 Km

Diagram Illustrating Benton's argument in favour of the Punjab Triple Canal System


JHELUM RIVER
CHENAB RIVER
1.2. It is therefore necessary to tail the Upper Jhelum canal into the Chenab river above the offtake of the Lower Chenab canal, and to supply as much water as the Upper Chenab canal will withdraw, 34 miles farther up stream.
1.3 This was the principal condition in fixing the high level chosen for the Upper Jhelum canal
1.1. The existing Lower Chenab canal fully utilises all the perennial supply of the Chenab river
2.1. The chief object of this canal is to convey the requisite perennial supply to the Lower Bari Doab Canal
2.2. but in order to add to the financial stability of the scheme it will also supply water to the Nokor and Raya branch canals
2.3. The formidable Deg torrent carrying a maximum flood-discharge of 34,000 cubic feet per second was encountered in the lower part of the canal, and was diverted to the Ravi river.

Mapping of the lower Bari Doab Canal's Distributaries in Isolation from the broader context



Showing British Knowledge of Idigenous territory & religious significance of sites within the Punjab

- Rivers
- Major canals
- Triple canals
- Inundation canals
- Contour
- Waterways
- Headworks
- Indigenous Territory
- Canal Colony
- Sikh Pilgrimage Site